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Disease Management Tips for the Greenhouse

This article is a little longer than usual, but has some good information. – M. Brown

Some Basic Non-Chemical Disease Management Practices for Greenhouses: Exclusion, Quarantine, Sanitation, and Monitoring

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Infectious plant disease occurs when there is an interaction among a susceptible host, a pathogen of that host and suitable environmental conditions for infection. Disease will not occur unless all three factors (host, pathogen and suitable environment) occur together. Therefore, all three factors should be considered in managing plant disease. Fungi, bacteria, viruses and nematodes are common causes of infectious plant diseases. Disease problems occur even in the best-managed greenhouses. Below are some recommendations of things that can be done to reduce the incidence of disease in greenhouses. Not all of them will be practical in all cases, but the more of these that can be implemented the less the chance for serious disease epidemics in the greenhouse.

Exclusion and Quarantine: The best way to eliminate problems caused by a pathogen is to keep the pathogen out of the greenhouse in the first place. Buy from reputable suppliers who follow good disease management practices. Use treated seed. Grow disease resistant cultivars. Purchase virus-indexed cuttings. Become familiar with the most serious diseases of the plants you grow. Examine incoming plant materials for diseases (and insect pests) using a hand lens. If disease is found notify your supplier and your state plant regulatory inspector. Do not put diseased plants into production areas. Quarantine plants for several days with virus indicator plants and insect sticky cards to monitor for insect pests and tospo viruses. (See section on "Monitoring for plant disease".) Keep any plants you are unsure about isolated from your production area. If possible grow plants from different suppliers in different areas, at least at first. Then if a disease has managed to slip in on one shipment, it will be less likely to infect your whole crop before you are aware of it. Monitor for diseases on a regular schedule. Don't wait for a problem to become widespread. Make the decision to rogue, treat, or quarantine plants for further observation when a problem is first found.

Most plant diseases are not seed borne and the use of treated seed can eliminate some of those that are. To protect your seed grown plants from diseases that may be present in plants grown from cuttings or

divisions it is a good practice to keep seed grown plants isolated. You may even want to keep a separate set of tools for use with these plants. Often growers isolate vegetable seedlings from ornamental seedling, as well, because pesticide options for ornamentals are often different from those available for vegetable transplants. Field exposed plants (such as divisions of field grown perennials and bulbs) should not be grown in the same greenhouse with annuals or cuttings of strictly greenhouse origin as they pose the risk of harboring soil borne diseases and insect vectored viruses. Foliage of any plants grown from bulbs, corms, rootstock or other plant parts purchased dormant should be carefully and regularly monitored for virus and foliar nematode symptoms. Dormant stock typically does not express symptoms of such infections. Symptoms may only be readily observed during a portion of the growing season. Your state plant regulatory inspector should be notified of such problems.

State departments of agriculture plant regulatory inspectors can often provide access to diagnostic services and control recommendations when problems are found. Exotic plant diseases and insects pests are a potential problem with plant stock of foreign origin, as are regional pests on stock grown out of state or in other regions of a state. State departments of agriculture can trace problem stock to its source and assist in preventing future shipments of such stock from the supplier. If the problem does not have regulatory implications, most states have a university extension plant disease diagnostic clinic that can help a grower with accurate diagnosis of plant problems.

In addition to being plant pests in their own right, insects often vector plant diseases. Examine incoming plant material closely for insect pests and quarantine for a few days while monitoring with sticky cards. If insect pests are found continue to quarantine affected plants until they are treated and the pest eradicated. Two important viruses found in greenhouse grown plants are *impatiens necrotic spot virus* and *tomato spotted wilt virus*. These two viruses belong to the *tospoviruses*. These viruses are spread by thrips, primarily western flower thrips. Infected hosts may sometimes be symptomless, so there is a potential for disease to spread before one is even aware of its presence; however, the disease will not spread unless thrips are present to vector the disease from plant to plant. When these viruses are present even one thrips is one thrips too many (thrips is one of those words that is both singular and plural, like deer).

Fungal spores may be carried in the guts of insects, such as fungus gnats, that feed on diseased and decomposing plant tissue, and can be spread to new areas of the greenhouse when the insects defecate.

To exclude insect pests that may spread disease make sure that the glazing is free of holes and tears. Entryway doors should close automatically and tightly. Ventilation fans should have exterior louvers that close when fans are not operating. Consider special screening over vents that exclude insect pests from the greenhouse. The areas around greenhouses should be free of vegetation or kept closely mowed. Avoid wearing yellow and blue. Insects may be attracted to these colors and may hitchhike into the greenhouse or between greenhouses on clothing.

Sanitation between crops: Remove all plants and plant debris from benches and floors. Throw out any plant stakes or twine used on a previous crop. Make sure the house is weed free. Treat soil under benches to kill thrips. Clean and disinfect potting areas, bench surfaces, walkways, walls, tanks, drip irrigation tubing, water wands, breakers, tools and carts. Repair any floor areas with poor drainage that accumulate water and algae. Repair any leaking pipes or faucets that may cause puddles.

Many plant pathogens are soil borne. The use of soilless growing media and disposable containers revolutionized the greenhouse industry. Because these were essentially pathogen free, growers were less likely to carry over disease problems, such as damping off and root rots. To maintain this benefit unused growing medium and containers should not be stored directly on greenhouse benches, floors or walkways or in such a way that they can become contaminated by water run off, used media, or soil. Contaminated medium should be not be used or should be steam pasteurized before use. It is best not to reuse plant

trays and pots. If reused they should be thoroughly and completely disinfected, but this is very hard to accomplish and is not as satisfactory in disease prevention as using new containers.

Vegetable houses where plants are grown directly in the native soil present special sanitation problems. Steam pasteurization or solarization of the soil beds may be used to kill soil borne pathogens that may carry over from one crop to the next.

Do not carry over plants as these can harbor diseases that may later infect the new crop. For the same reason, you should not keep "pet" plants in production areas. If long-term plantings are used in display areas these areas should be separate from production areas and the plants should be carefully, regularly, and frequently monitored for diseases and for the insect pests that could vector disease.

Sanitation during production: People can vector plant diseases. Wash hands before handling plants, growing media and tools. When working in the greenhouse hands and tools should be periodically washed and/or disinfected. Don't examine mysteriously unthrifty plants or plants known to have a disease and then go on to work with other plants in the greenhouse without first cleaning hands and any tools used. Tobacco products may carry tobacco mosaic virus, which has a wide host range among plants. Tobacco products should not be used in the greenhouse and when tobacco products are used elsewhere the user should always wash his or her hands before returning to work.

Pinching or cutting back plants injures the stem and provides an ideal site for some types of pathogens to infect so these operations should be done only when plant surfaces are dry and hands and tools should be disinfected often.

Clothing should be worn for only one day before being laundered. A disinfectant mat or footbath at doorways can help prevent pathogens from being brought in on footwear.

Because drainage from pots may carry pathogens and because pathogen can be carried in on shoes and boots, the floor of the greenhouse should be considered contaminated even though it is disinfected periodically. Plants should not be grown directly on the floor. Do not let hose ends or pots touch the floor.

Animals may carry pathogens on their feet and fur. Pets should be excluded from the greenhouse or limited in their access so bench tops, propagation areas, and growing media storage areas remain uncontaminated. Rodent pests should be controlled.

Avoid water splash between pots. Many diseases are readily spread in this manner. You may need to increase pot spacing and/or reduce the size and force of the water droplets when watering.

Avoid growing hanging baskets over benches. Pathogens on the basket plants can quickly spread to the plants below. Deadhead flowers often.

Remove plant debris promptly from the greenhouse. Plant debris, especially if it is diseased, should be removed from the greenhouse in a covered container such as a closed plastic bag or a covered trash barrel. Plastic bags should not be reused and trash barrels should be cleaned before being returned to the greenhouse. Ideally, diseased plant debris should be destroyed. Compost piles for other types of plant debris should be located as far from the greenhouse as feasible.

Keep the greenhouse weed free. Weeds can harbor diseases and pests and make control more difficult. Avoid creating airborne dust. Dust may contain propagules of pathogens and spread diseases to new locations as it moves and settles.

Cultural methods: Disease problems are not just a matter of the host plant being in the presence of the pathogen, but also of the environment in which the pathogen and the host find themselves being suitable for infection to occur. Characteristics of the growing medium, the amount and proportion of mineral nutrients, temperatures around the roots and aerial portions of the plants, light, moisture, and humidity levels, etc. can all make a difference in the susceptibility of the host plant and the ability of the pathogen to infect and cause disease. Learn the optimum growing conditions for the plants you grow and try to meet these conditions. Learn the major disease problems in your crops and try to avoid conditions favorable to these diseases. Unfortunately, in some cases conditions that are optimum for the crop are also optimum for its pathogens. If disease problems are chronic on certain hosts you may opt to avoid the problem by growing other cultivars or species.

Most plant pathogens require a wet surface to infect. Space plants to allow good air circulation so that foliage dries quickly after wetting. If you are using overhead watering try to water at times when foliage will dry quickly. Prune or pinch plants only when plant surfaces are dry.

Regulate the relative humidity by venting and heating. Powdery mildews can infect under conditions of high humidity and growth of Botrytis blight and some other diseases is favored by conditions of high humidity. Spacing plants so that air circulates around the plants can reduce the relative humidity in the canopy.

Insects can spread disease. Thrips, whiteflies, aphids and other insects can vector viruses. The tospo viruses are a particular problem in greenhouse production because they are spread by thrips, which are common in greenhouses and hard to control. Western flower thrips is the most important vector of tospo viruses, but other thrips can occasionally spread these diseases. Fungus gnats, which feed on rotted, diseased plant material, may spread pathogens in their fecal matter. Monitor for insect pests using sticky cards. Yellow sticky cards are attractive to most insects. Yellow or blue sticky cards may be used for thrips. Control insects as needed.

Avoid over or under watering. Use a well-drained growing medium and water as frequently as needed to prevent wilting. Using a highly water retentive growing medium to avoid frequent watering on hot days will leave plant roots too wet on cool cloudy days. Wet conditions in the root ball are ideal for root pathogens. On the other hand, plants that are allowed to get too dry will be stressed which may predispose plants to infection.

Avoid excessive use of mineral nutrients, particular nitrogen, because excess nitrogen tends to cause plant tissue to mature more slowly. Young, tender, succulent plant tissue is more susceptible to many plant diseases than older, more hardened tissue. Check the pH of the growing medium. The pH requirements of species and cultivars may differ. The pH of the growing medium can affect the absorption of nutrients and affect the susceptibility of roots to some root pathogens.

Monitoring for plant disease: This includes both the scouting of random plants once or twice a week and the daily observation of indicator plants (and don't forget to check those sticky cards for insect pests). These practices allow a grower to find disease problems and make management decisions before the disease becomes a major problem. The management decision that the grower makes will depend on the disease present, the crop grown, and the grower's own growing philosophy, but the more information and the sooner it is available the more likely the grower will be to make a good decision early enough to make a difference. If the decision is made to use fungicides to control a problem it should be implemented as soon as possible after the disease problem is first found and identified. Most fungicides must be in place before the pathogen is present to be effective. Unlike insects and mites, which are either present (although perhaps hiding or as eggs and difficult to find) or not present, diseases may be present without the plant showing any visible symptom for varying periods after the initial infection occurs. Therefore, when a plant disease problem is found there is a strong likelihood that the problem is already more

extensive than it appears. If the disease found has the potential to cause serious crop injury do not delay making a management decision.

Scouting: Because people tend to see best that which they know to look for, it is important to learn to recognize and look for the symptoms of the common greenhouse diseases, such as Botrytis blight and root rots, and any problems to which a particular crop is prone. Have good reference materials that include pictures of symptoms. Equip yourself with a 10X or better hand lens. Don't forget to check for insects and mites at the same time.

Plan to check a minimum of 10 plants per 1000 ft^2 of production area and allow sufficient time for a thorough examination of each plant. Randomly select plants from the edge, the middle, and as far back as you can reach on the bench. (Topliff, et al. 2001) Except for indicator plants you should try not to do the same plants and areas on the following scouting trip lest you miss a problem that is developing in a different spot. Pay particular attention to the areas near openings such as vents and doors where plant pests can gain entry to the greenhouse. In addition to looking at randomly selected healthy appearing plants be alert for any plants that appear "off", such as being slightly wilted or showing a difference in growth or leaf color.

Inspect from the bottom of the plant upward. Be sure to inspect both sides of the leaves. Tilt the pot on its side to more easily inspect the undersides of leaves. If a crop is particularly prone to root diseases or if symptoms indicate there might be a root problem present, tip the plant out of the pot and examine exposed roots.

If a problem is found examine nearby plants. Mark or flag affected plants in some way, such as with plant stakes. These plants will then be easily found again when a decision has been made whether to rogue, to quarantine, or to use them as indicator plants to monitor further development of a suspected problem and/or the effectiveness of any treatments that are applied. It is rare that a plant disease, once present, can be eradicated by the use of chemicals, so there is always some risk involved in leaving infected plants in the greenhouse. Heavily diseased plants should always be discarded, as should plants with root rots. When appropriate chemicals are used to help prevent further spread of foliar diseases, plants lightly affected may remain in place, but they and the surrounding area should be carefully monitored daily to make sure the chemical applied is working effectively, and if not, prompt action should be taken to rogue or quarantine. When you have found and handled diseased plants, remember to wash your hands and disinfect any tools used before handling other susceptible plants.

Indicator plants: Indicator plants should be examined daily. Except for the above noted use of affected crop plants to keep track of known or suspected problems, the main use of indicator plants in plant disease monitoring is to check for the presence of two tospoviruses, impatiens necrotic spot virus (INSV) and tomato spotted wilt virus (TSWV). This practice has not been widely adopted by the greenhouse industry, but can be very useful. Before a new crop season and after the empty greenhouse has been treated for thrips, an indicator plant can be placed in an empty greenhouse to check for the presence of any remaining thrips and whether those thrips are carrying topsoviruses. If incoming plant material is quarantined for 3 or 4 days before being placed in the production area an indicator plant can be placed with the quarantined plants to check for the presence of both thrips and tospo viruses in the plant shipment. Sticky cards can be used here to further check for insect pests on the new plant material. Indicator plants can also be placed among susceptible crop plants at intervals of 20 to 30 feet (Pundt 1992, Smith 1998). If the indicator plants are small more plants should be used.

Petunia cultivars 'Summer Madness', 'Burgundy Madness' (Ball Seed), 'Red Cloud' (Goldsmith Seed), and 'Carpet Blue' and fava beans (Daughtrey, et al 1999, Robb, et al 2002) are recommended for this purpose. These petunia cultivars are quite attractive to thrips, which vector the viruses, form local lesions quickly at thrips feeding sites and are not systemic hosts of the tospo viruses. This latter means that the

infection is limited to the disease lesion and uninfected thrips are unlikely to become infected by feeding on the indicator plant. Petunia leaves with disease lesions can be picked off and the plant can continue to be used as an indicator. Fava beans, although they are easier to grow, are a systemic host of the tospo viruses and must be removed and destroyed once symptoms have been observed lest they contribute to the further spread of the disease in the greenhouse.

Thrips feeding on these plants leaves a white scar. If the thrips are vectoring a tospo virus, the lesion will develop a dark rim within a few days. Since this symptom occurs only on leaves and since thrips feed preferentially on flowers, flowers should be removed. To enhance the effectiveness of indicator plants make them even more attractive to thrips by placing a blue or yellow **non-sticky** card in the pot at plant level. Blue plastic picnic plates cut in half have been used successfully for this purpose (Pundt undated web page).

Next issue – What to look for on in-coming nursery stock!

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Grower's associations and trade publications are often a good source of disease management information. When new problems arise or when new solutions are found their sources are often among the first to know and to get out the news quickly to the growers.